

AF/2812

Docket No.: 50090-306

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

Shiroshi TOBIMATSU, et al.

Serial No.: 09/910,824

Group Art Unit: 2812

Filed: July 24, 2001

Examiner: LEE, Hsien Ming

For: METHOD OF MANUFACTURING SEMICONDUCTOR DEVICE HAVING PASSIVATION
FILM AND BUFFER COATING FILM

TRANSMITTAL OF APPEAL BRIEF

Mail Stop Appeal Brief
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Submitted herewith in triplicate is Appellant(s) Appeal Brief in support of the Notice of Appeal filed December 30, 2002. Since an Appeal Brief fee was previously filed on December 30, 2001, there is no fee due for this Appeal Brief.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

MCDERMOTT, WILL & EMERY

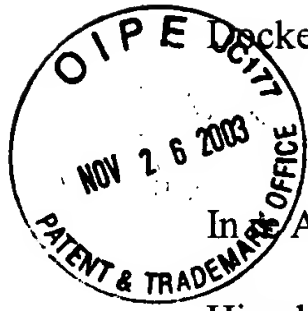
Arthur J. Steiner

Registration No. 26,106

600 13th Street, N.W.
Washington, DC 20005-3096
(202) 756-8000 AJS:ntb
Date: November 25, 2003

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APPEAL BRIEF

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P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This Appeal Brief is submitted in support of the Notice of Appeal filed October 17, 2003.

I. REAL PARTY IN INTEREST

The real party in interest is Mitsubishi Denki Kabushiki Kaisha.

II. RELATED APPEALS AND INTERFERENCES

Appellants are unaware of any related Appeals or Interferences.

III. STATUS OF CLAIMS

Claims 1 through 4 and 6 are pending in this application and have been finally rejected. It is from the final rejection of claims 1 through 4 and 6 that this Appeal is taken.

IV. STATUS OF AMENDMENTS

An amendment was filed pursuant to 37 C.F.R. §1.116 on September 16, 2003, subsequent to the June 18, 2003 Final Office Action. According to the Advisory Action issued October 10, 2003, that Amendment submitted on September 16, 2003 will be entered if an Appeal is taken and would overcome the objection to claim 1. Appellants are proceeding on the basis that the Amendment submitted pursuant to 37 C.F.R. §1.116 on September 16, 2003 has been entered as an Appeal was taken and an Appeal Brief submitted.

V. SUMMARY OF THE INVENTION

Adverting to Figs. 3A-3F, conventional practices, as discussed on page 1 of the written description of the specification, commencing at line 18, comprise, inter alia, forming a polyimide mask for (4, Fig. 3D) over an aluminum interconnection (2) with a passivation film (3) therebetween, and curing the polyimide. However, as shown in Fig. 3E, during curing the polyimide undergoes a volumetric shrinkage of about 50% (page 2 of the written description, lines 19 and 20). When this occurs, the sidewall of the polyimide pattern changes from vertical (Fig. 3D) to tapered (Fig. 3E), thereby jeopardizing the accuracy of the finished dimension (3A) of the passivation film (3) to be etched, causing variations in the final dimension (ultimate full paragraph on page 2 of the written description).

The present invention addresses and solves the above **problem** by strategically etching the passivation film (3, Fig. 1E) before the polyimide mask (4) is cured (page 5 of the written description, lines 17 and 18). In this way, the integrity of the vertical sidewalls of the polyimide mask (4) is maintained, thereby improving controllability of the finished dimension (3A, Fig. 1E, 1F) as disclosed at page 5 of the written description, lines 20 through 22 and lines 29 through 33). **But another problem occurs at this point.** Specifically as disclosed in the paragraph bridging pages 5 and 6 of the specification, a hardened polyimide layer (4B) is formed on surface of the polyimide film (4) as illustrated in Fig. 2A. Unlike the polyimide film (4) which undergoes a significant volume shrinkage, no volume change occurs in the hardened layer (4B), as disclosed first full paragraph on page 6 of the written description. As result of such a difference in shrinkage, a myriad of wrinkles occurs, as illustrated in Fig. 4C, which adversely impacts adhesion between a sealing resin and a polyimide film (4A), as disclosed in the second full paragraph on page 6 of the written description.

In other words, Appellants solve the prior art problem, but discovered that the solution engenders another problem. So Appellants went one step further and came up with the solution of ashing to remove the hardened layer (4B) **after etching and before curing** (third full paragraph on page 6 of the written description). In this way, dimensional accuracy is improved without sacrificing adhesion to the sealing resin (first full paragraph on page 7 of the written description). The notion of purposely removing a hardened polyimide film before curing, particularly the amount specified in claim 1, is not even a blip on the radar screens of the applied references.

VI. ISSUES

A. The Rejection

Claims 1 through 4 and 6 stand finally rejected under 35 U.S.C. §103 for obviousness predicated upon Shinohara in view of Sakurai and Fu et al.

B. The Issue Which Arises In This Appeal and Requires Resolution by the Honorable Board of Patent Appeals and Interferences (the Board) is:

Whether claims 1 through 4 and 6 are unpatentable under 35 U.S.C. §103 for obviousness predicated upon Shinohara in view of Sakurai and Fu et al.

VII. GROUPING OF CLAIMS

The appeals claims stand or fall together with independent claim 1.

VIII. THE ARGUMENT

The Examiner's Position

Shinohara discloses a method wherein etching is conducted using a polyimide film, followed by treatment of the substrate with an oxygen plasma, which may also remove fluorine ions from the polyimide film, followed by curing the polyimide film. The Examiner admits that the notion of a hardened polyimide surface is nowhere to be found in Shinohara. In the Examiner's words: "Shinohara is silent as to the formation of a hardened film on the surface of the photoresensitive polyimide film 16 resulting from the etching step" (page 3 of the June 18, 2003 Final Office Action, ultimate full paragraph). How then does the Examiner get to the present invention?

The Examiner asserts inherency. The Examiner's inherency argument is predicated upon the **assumption** that during ashing of the substrate, which is the intention of Shinohara, the upper surface of the polyimide film 16 would be exposed to ashing and the assumed hardened surface layer would also be ashed.

Still not there because independent claim 1 specifies that a particular amount of the hardened surface layer must be removed, the Examiner commits clear legal error by first speculating that "The hardened layer is a residue resulting from ashing and harmful to the device" (paragraph bridging pages 2 and 3 of the October 10, 2003 Advisory Action), as though there is any factual basis upon which to conclude that one having ordinary skill in the art would have even recognized the formation of a hardened layer and understood that it was harmful. The Examiner then speculates in that same paragraph, that "If the hardened layer is formed to a thickness of 2 micrometer, **then** one having ordinary skill in the art would have been motivated (as though one having ordinary skill in the art knew about the hardened layer) to remove the thickness of 2 micrometer from the surface of the polyimide film, i.e., it is a routine experimentation with optimum process" (Emphasis supplied). In short, the Examiner goes from an **unknown element** which is **admittedly missing** in Shinohara, i.e., the hardened layer, **assumes** one having ordinary skill in the art would have recognized it, **and recognized that was harmful**, and then optimized the amount to be removed- - all that from an admitted **silence** in the primary reference. Appellants submit that the Examiner's approach is clearly legally erroneous.

Appellants' Position

There is no Inherency

It is undisputed that inherency requires certainty. *Electro Medical Systems S.A. v. Cooper Life Sciences, Inc.*, 34 F.3d 1048, 32 USPQ2d 1017 (Fed. Cir. 1994); *Glaxo Inc. v. Novopharm Ltd.*, 52 F.3d 1043, 34 USPQ2d 1565 (Fed. Cir. 1995); *In re Rijckaert*, 9 F.3d 1531, 28 USPQ2d 1955 (Fed. Cir. 1993); *Continental Can Co. USA, Inc. v. Monsanto Co.*, 948 F.2d 1264, 20 USPQ2d 1746 (Fed. Cir. 1991). There is no certainty. The reason there is no certainty is that Shinohara optimizes the oxygen plasma for treatment of the **substrate, not** the upper surface of the polyimide film which may contain some fluorine ions which are removed. The Examiner erroneously **assumes** that the conditions employed by Shinohara **necessarily** remove a hardened upper surface of the polyimide film, **assuming** that the hardened polyimide film is formed to begin with if Shinohara's etching technique fortuitously forms a hardened polyimide film.

When confronted with the requirement for the necessity, the Examiner heads for the tall grass invoking the secondary references to Sakurai and Fu et al. But a similar etchant does not mean that the same conditions were employed. Further, Sakurai is of no avail because Sakurai does not employ a photoresist polyimide film which is the film employed by Shinohara. The reference to Fu et al. is of no help, because Fu et al. neither disclose nor suggest the formation of a hardened film on a photosensitive polyimide film. The Examiner beats the underbrush in the secondary references but comes up short. But this not the only error.

The "routine experimentation" rubric.

The fatal flaw in the Examiner's analysis is that the applied prior art neither discloses nor

suggests that the amount of hardened polyimide removed during oxygen ashing (of the underlying substrate) is an art recognized result effective variable. The Examiner **assumes** that one having ordinary skill in the art would have recognized that Shinohara's process **necessarily** forms a hardened polyimide film, **assumes** that one having ordinary skill in the art would have recognized that it is undesirable, **assumes** one having ordinary skill in the art would have taken the trouble to measure its thickness, and then **assumes** one having ordinary skill in the art would have optimized the amount removed. All this without a teaching in the applied prior art that the amount removed during oxygen ashing, **if**, one having ordinary skill in the art would have even recognized that it is even removed during oxygen ashing, is an art recognized result effective variable.

The law is clear - - it is legally erroneous for the Examiner to say that one having ordinary skill in the art would have been led to remove any particular amount of the upper surface of the polyimide film based on "routine experimentation" when the amount of hardened polyimide film has not been factually established as an art recognized result effective variable. *In re Rijckaert, supra; In re Antonie, 559 F.2d 618, 195 USPQ 6 (CCPA 1977).*

Denial of Due Process of Law

The Examiner would impose upon Appellants the burden of establishing the criticality of the amount of the hardened polyimide removed **before** establishing a prima facie basis to deny patentability to the claimed invention. There is no requirement upon Appellants to demonstrate criticality, or even present an argument, until such time as the Examiner establishes a prima facie basis to deny patentability to the claimed invention. *In re Deuel, 51 F.3d 1552, 34 USPQ2d 1210 (Fed. Cir. 1995); In re Rijckaert, supra; In re Bell, 991 F.2d 781, 26 USPQ2d 1529 (Fed. Cir.*

1993); *In re Oetiker*, 977 F.2d 1443, 24 USPQ2d 1443 (Fed. Cir. 1992). The Examiner did **not** establish a prima facie basis to deny patentability to the claimed invention. Ergo, there is no requirement for Applicants to demonstrate the criticality of any claim limitation.

Indicium of Nonobviousness

The problem addressed and solved by a claimed invention must be given consideration resolving the ultimate legal conclusion of obviousness under 35 U.S.C. §103. *North American Vaccine, Inc. v. American Cyanamid Co.*, 7 F.3d 1571, 28 USPQ2d 1333 (Fed. Cir. 1993); *Northern Telecom, Inc. v. Datapoint Corp.*, 908 F.2d 931, 15 USPQ2d 1321 (Fed. Cir. 1990); *In re Newell*, 891 F.2d 899, 13 USPQ2d 1248 (Fed. Cir. 1989); *In re Nomiya*, 509 F.2d 566, 184 USPQ 607 (CCPA 1975). The present invention stems from the recognition that a hardened photoresist layer is formed which adversely impacts dimensionally integrity (page 6 of the written description of the specification, lines 10 through 20). This problem is not even a blip on the radar screen of Shinohara. Indeed, Shinohara addresses a **different problem** from that addressed by the claimed invention. Shinohara is concerned with a problem attendant upon oxygen ashing which disassociates the imide coupling, thereby reducing adhesion of the polyimide to the mold resin. On the other hand, the present invention is primarily concerned with dimensional accuracy and, in order to achieve that objective, forms an **undesirable** hard polyimide film which is then **purposely removed** by oxygen ashing. On the other hand, oxygen ashing is employed by Shinohara is for the purpose of **reducing fluorine** contaminants.

Accordingly, the problem addressed and solved by the claimed invention merits consideration as **potent indicium of nonobviousness**.

Conclusion

Based upon the foregoing, Appellants submit that a prima facie basis to deny patentability to the claimed invention under 35 U.S.C. §103 has not been established. Applicants submit that the Examiner's attempt to invoke the doctrine of inherency is misplaced. Moreover, upon giving due consideration to the problem addressed and solved by the claimed invention, the conclusion appears inescapable that one having ordinary skill in the art would **not** have found the claimed invention **as a whole** obvious within the meaning of 35 U.S.C. §103. *Jones v. Hardy*, 727 F.2d 1524, 220 USPQ 1021 (Fed. Cir. 1984).

Appellants, therefore, submit that the imposed rejection of claims 1 through 6 under 35 U.S.C. §103 for obviousness predicated upon Shinohara in view of Sakurfai and Fu et al. is not factually or legally viable.

IX. PRAYER FOR RELIEF


As argued above, the Examiner's rejection of the appealed claims under 35 U.S.C. §103 is factually and legally erroneous. Appellants, therefore, respectfully solicit the Honorable Board to reverse the Examiner's rejection of claims 1 through 4 and 6 under 35 U.S.C. §103.

To the extent necessary, a petition for an extension of time under 37 CFR § 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Serial No.: 09/910,824

Respectfully submitted,

MCDERMOTT, WILL & EMERY



Arthur J. Steiner
Registration No. 26,106

600 13th Street, N.W.
Washington, DC 20005-3096
(202) 756-8000 AJS:ntb
Date: November 26, 2003

APPENDIX

1. A method of manufacturing a semiconductor device comprising the steps of:

forming an interconnection on a semiconductor substrate having a semiconductor element formed thereon;

forming a passivation film on the semiconductor substrate including the interconnection;

forming a polyimide film, which serves as a buffer coating film, on the passivation film;

patterning the polyimide film;

etching the passivation film, while the patterned polyimide film is used as a mask, under conditions which form a hardened polyimide layer on the surface of the polyimide film;

ashing to remove 0.1 μm to several micrometers of the polyimide film, thereby removing the hardened layer formed on the surface of the polyimide film as a result of said step of etching;

and

curing the semiconductor substrate after ashing process so as to transform the polyimide film into imide.
2. The method of manufacturing a semiconductor device according to claim 1, wherein the polyimide film is formed by means of applying varnish which is formed by dissolving into an organic solvent polyamic acid serving as a precursor of polyimide.
3. The method of manufacturing a semiconductor device according to claim 1, wherein the polyimide film is a photosensitive polyimide film.
4. The method of manufacturing a semiconductor device according to claim 1, wherein in said step of removing, ashing process is effected through use of oxygen plasma.

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6. The method of manufacturing a semiconductor device according to claim 1, wherein said step of curing is effected at 300°C to 450°C for 0.1 to several hours.



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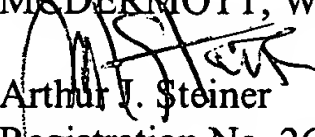
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Registration No. 26,106

600 13th Street, N.W.
Washington, DC 20005-3096
(202) 756-8000 AJS:ntb
Date: November 25, 2003

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The real party in interest is Mitsubishi Denki Kabbushiki Kaisha.

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Appellants are unaware of any related Appeals or Interferences.

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In other words, Appellants solve the prior art problem, but discovered that the solution engenders another problem. So Appellants went one step further and came up with the solution of ashing to remove the hardened layer (4B) **after etching and before curing** (third full paragraph on page 6 of the written description). In this way, dimensional accuracy is improved without sacrificing adhesion to the sealing resin (first full paragraph on page 7 of the written description). The notion of purposely removing a hardened polyimide film before curing, particularly the amount specified in claim 1, is not even a blip on the radar screens of the applied references.

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VIII. THE ARGUMENT

The Examiner's Position

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The Examiner asserts inherency. The Examiner's inherency argument is predicated upon the **assumption** that during ashing of the substrate, which is the intention of Shinohara, the upper surface of the polyimide film 16 would be exposed to ashing and the assumed hardened surface layer would also be ashed.

Still not there because independent claim 1 specifies that a particular amount of the hardened surface layer must be removed, the Examiner commits clear legal error by first speculating that "The hardened layer is a residue resulting from ashing and harmful to the device" (paragraph bridging pages 2 and 3 of the October 10, 2003 Advisory Action), as though there is any factual basis upon which to conclude that one having ordinary skill in the art would have even recognized the formation of a hardened layer and understood that it was harmful. The Examiner then speculates in that same paragraph, that "If the hardened layer is formed to a thickness of 2 micrometer, ~~then~~ one having ordinary skill in the art would have been motivated (as though one having ordinary skill in the art knew about the hardened layer) to remove the thickness of 2 micrometer from the surface of the polyimide film, i.e., it is a routine experimentation with optimum process" (Emphasis supplied). In short, the Examiner goes from an unknown element which is admittedly missing in Shinohara, i.e., the hardened layer, assumes one having ordinary skill in the art would have recognized it, and recognized that was harmful, and then optimized the amount to be removed- - all that from an admitted silence in the primary reference. Appellants submit that the Examiner's approach is clearly legally erroneous.

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The fatal flaw in the Examiner's analysis is that the applied prior art neither discloses nor

suggests that the amount of hardened polyimide removed during oxygen ashing (of the underlying substrate) is an art recognized result effective variable. The Examiner **assumes** that one having ordinary skill in the art would have recognized that Shinohara's process **necessarily** forms a hardened polyimide film, **assumes** that one having ordinary skill in the art would have recognized that it is undesirable, **assumes** one having ordinary skill in the art would have taken the trouble to measure its thickness, and then **assumes** one having ordinary skill in the art would have optimized the amount removed. All this without a teaching in the applied prior art that the amount removed during oxygen ashing, if, one having ordinary skill in the art would have even recognized that it is even removed during oxygen ashing, is an art recognized result effective variable.

The law is clear - - it is legally erroneous for the Examiner to say that one having ordinary skill in the art would have been led to remove any particular amount of the upper surface of the polyimide film based on "routine experimentation" when the amount of hardened polyimide film has not been factually established as an art recognized result effective variable. *In re Rijckaert, supra; In re Antonie, 559 F.2d 618, 195 USPQ 6 (CCPA 1977).*

Denial of Due Process of Law

The Examiner would impose upon Appellants the burden of establishing the criticality of the amount of the hardened polyimide removed **before** establishing a prima facie basis to deny patentability to the claimed invention. There is no requirement upon Appellants to demonstrate criticality, or even present an argument, until such time as the Examiner establishes a prima facie basis to deny patentability to the claimed invention. *In re Deuel, 51 F.3d 1552, 34 USPQ2d 1210 (Fed. Cir. 1995); In re Rijckaert, supra; In re Bell, 991 F.2d 781, 26 USPQ2d 1529 (Fed. Cir.*

1993); *In re Oetiker*, 977 F.2d 1443, 24 USPQ2d 1443 (Fed. Cir. 1992). The Examiner did **not** establish a prima facie basis to deny patentability to the claimed invention. Ergo, there is no requirement for Applicants to demonstrate the criticality of any claim limitation.

Indicium of Nonobviousness

The problem addressed and solved by a claimed invention must be given consideration resolving the ultimate legal conclusion of obviousness under 35 U.S.C. §103. *North American Vaccine, Inc. v. American Cyanamid Co.*, 7 F.3d 1571, 28 USPQ2d 1333 (Fed. Cir. 1993); *Northern Telecom, Inc. v. Datapoint Corp.*, 908 F.2d 931, 15 USPQ2d 1321 (Fed. Cir. 1990); *In re Newell*, 891 F.2d 899, 13 USPQ2d 1248 (Fed. Cir. 1989); *In re Nomiya*, 509 F.2d 566, 184 USPQ 607 (CCPA 1975). The present invention stems from the recognition that a hardened photoresist layer is formed which adversely impacts dimensionally integrity (page 6 of the written description of the specification, lines 10 through 20). This problem is not even a blip on the radar screen of Shinohara. Indeed, Shinohara addresses a **different problem** from that addressed by the claimed invention. Shinohara is concerned with a problem attendant upon oxygen ashing which disassociates the imide coupling, thereby reducing adhesion of the polyimide to the mold resin. On the other hand, the present invention is primarily concerned with dimensional accuracy and, in order to achieve that objective, forms an **undesirable** hard polyimide film which is then **purposely removed** by oxygen ashing. On the other hand, oxygen ashing is employed by Shinohara is for the purpose of **reducing fluorine** contaminants.

Accordingly, the problem addressed and solved by the claimed invention merits consideration as **potent indicium of nonobviousness**.

Conclusion

Based upon the foregoing, Appellants submit that a prima facie basis to deny patentability to the claimed invention under 35 U.S.C. §103 has not been established. Applicants submit that the Examiner's attempt to invoke the doctrine of inherency is misplaced. Moreover, upon giving due consideration to the problem addressed and solved by the claimed invention, the conclusion appears inescapable that one having ordinary skill in the art would **not** have found the claimed invention **as a whole** obvious within the meaning of 35 U.S.C. §103. *Jones v. Hardy*, 727 F.2d 1524, 220 USPQ 1021 (Fed. Cir. 1984).

Appellants, therefore, submit that the imposed rejection of claims 1 through 6 under 35 U.S.C. §103 for obviousness predicated upon Shinohara in view of Sakurfai and Fu et al. is not factually or legally viable.

IX. PRAYER FOR RELIEF

As argued above, the Examiner's rejection of the appealed claims under 35 U.S.C. §103 is factually and legally erroneous. Appellants, therefore, respectfully solicit the Honorable Board to reverse the Examiner's rejection of claims 1 through 4 and 6 under 35 U.S.C. §103.

To the extent necessary, a petition for an extension of time under 37 CFR § 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

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Respectfully submitted,

MCDERMOTT, WILL & EMERY

A handwritten signature in black ink, appearing to read "Arthur J. Steiner". The signature is stylized with a large, looped initial "A" and "S".

Arthur J. Steiner
Registration No. 26,106

600 13th Street, N.W.
Washington, DC 20005-3096
(202) 756-8000 AJS:ntb
Date: November 26, 2003

APPENDIX

1. A method of manufacturing a semiconductor device comprising the steps of:
forming an interconnection on a semiconductor substrate having a semiconductor element formed thereon;
forming a passivation film on the semiconductor substrate including the interconnection;
forming a polyimide film, which serves as a buffer coating film, on the passivation film;
patterning the polyimide film;
etching the passivation film, while the patterned polyimide film is used as a mask, under conditions which form a hardened polyimide layer on the surface of the polyimide film;
ashing to remove 0.1 μm to several micrometers of the polyimide film, thereby removing the hardened layer formed on the surface of the polyimide film as a result of said step of etching;
and
curing the semiconductor substrate after ashing process so as to transform the polyimide film into imide.
2. The method of manufacturing a semiconductor device according to claim 1, wherein the polyimide film is formed by means of applying varnish which is formed by dissolving into an organic solvent polyamic acid serving as a precursor of polyimide.
3. The method of manufacturing a semiconductor device according to claim 1, wherein the polyimide film is a photosensitive polyimide film.
4. The method of manufacturing a semiconductor device according to claim 1, wherein in said step of removing, ashing process is effected through use of oxygen plasma.

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6. The method of manufacturing a semiconductor device according to claim 1, wherein said step of curing is effected at 300°C to 450°C for 0.1 to several hours.